BELLCOMM, INC.
1100 Seventeenth Street, N.W. Washington, D.C. 20036

SUBJECT: The Existence of a 1981 Triple-Planet Ballistic Flyby - Case 103-2

DATE: September 19, 1967

FROM: J. Bankovskis
A. A. VanderVeen

ABSTRACT

A triple-planet flyby opportunity was found in mid-1981. The opportunity is discussed and compared to the 1977 triple-planet flyby. It is speculated that an opportunity should exist for a triple-planet flyby approximately every 2 years rather than every 6.4 years as was thought previously.

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MEMORANDUM FOR FILE

An opportunity exists, beginning in mid-1981, for a triple-planet (Earth-Venus-Mars-Venus-Earth) ballistic flyby.

The data and discussion presented here is based on a "first look" at the solutions found. A later report will cover a more thorough study of this flyby opportunity.

A mission which has favorable characteristics is listed in Table I.

TABLE I

EVENT	DATE		V_∞	PASS RAD.	PERI VEL.	INJ/ENTRY VEL.
	(Julian)	(Calendar)	(Emos)	(P.R.)	(FPS)	(FPS)
Earth Dep.	244 4750	5/26/81	0.2262			16,600
Venus Pass	244 4966	12/28/81	0.2029	2.5321	25,321	
Mars Pass	244 5278	10/5/82	0.2534	1.8770	18,770	
Venus Pass	244 5394	3/1/83	0.3673	1.8372	18,372	
Earth Arr.	244 5540	7/25/83	0.1957			41,000

The mission listed in Table I lasts 790 days. Others range from 720 to 850 days. A launch window of at least 30 days was found whose departure V_∞ ranges from 0.21 to 0.25 emos.

In some instances two passage dates at the first Venus encounter were found (having different V∞ and declinations at departure) which leads one to suspect that other families of solutions exist, possibly similar to Reference 1.

The solutions found generally have aphelion distances around 1.67 a.u. so that protection from asteroid particles should not be a problem.

A triple-planet flyby is essentially found by matching an outbound Venus swingby to Mars with an inbound swingby to earth. The 1977 opportunity (Reference 1) uses a Type #5* outbound swingby to Mars followed by a Type #5 homebound to earth. Due to the symmetry properties of this triple-planet flyby it was originally thought that this would be the only type possible. The opportunity exists approximately every 6.4 years for matching #5 swingbys.

The present opportunity uses a Type #7 outbound followed by a Type #3 inbound. It is conceivable, therefore, that there also exist triple-planet opportunities which utilize a Type #3 outbound followed by a Type #7 inbound. However, these opportunities have not as yet been verified.

If each of the above types of opportunity exists, a triple-planet flyby mission will be available approximately three times more often than previously thought.

In conclusion, the 1981 triple-planet flyby opportunity looks attractive from the standpoint of launch window, V∞ at departure and arrival, and passage distances. The trip times, however, are quite long.

The discovery of this triple-planet flyby opportunity opens up a new class of possible solutions and decreases the time between successive opportunities.

J. Bankovskis

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A. A. VanderVeen

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Attachment
References 1 - 2

*Type #5, Type #3, etc. refers to Earth-Mars-Venus constellations for various opportunities. See Reference 2 for a discussion of this classification.

REFERENCES

1. VanderVeen, A. A., "Families of 1977 Triple-Planet Flyby," Bellcomm Memorandum for File dated June 6, 1967.

2. Gillespie, R. W., and Ross, S., "The Venus Swingby Mission Mode and Its Role in the Manned Exploration of Mars," AIAA Third Aerospace Sciences Meeting, Paper No. 66-37, 1966.

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